Periodic Table Notes: History and Information

In the Beginning

1. Prerequisite to the construction of the periodic table was the discovery of the individual elements
2. The next 200 years, chemists acquired a vast body of knowledge concerning the properties of elements
3. By 1869, a total of 63 elements had been discovered

Law of Triads

4. In 1817 Johann Döbereiner proposed that nature contained triads of elements the middle element had properties that were an average of the other two members when ordered by the atomic weight (the Law of Triads).

First Attempts at Designing a Periodic Table

5. A.E. Beguyer deChancourtois transcribed a list of the elements on a cylinder by increasing atomic weight.
6. This led deChancourtois to propose that that "the properties of the elements are the properties of numbers."

Law of Octaves

7. In 1863 John Newlands classified the 56 known elements into 11 groups based on similar physical properties.
8. He noted that many pairs of similar elements existed which differed by some multiple of eight in atomic weight.
9. The Law of Octaves stated that any given element will exhibit analogous behavior to the eighth element following it in the table.

Who Is The Father of the Periodic Table?

10. There has been some disagreement about who deserves credit the German Lothar Meyer or the Russian Dmitri Mendeleev
11. Both chemists produced remarkably similar results at the same time working independently of one another.
12. Meyer's 1864 textbook included a _____

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13. In 1869, Dmitri Mendeleev organized his material in terms of _____
_____
_____

    a. He observed similarities between the series Cl-K-Ca , Br-/Rb-Sr and I-Cs-Ba.
    b. In an effort to extend this pattern to other elements, _____
    _____
    _____
    c. Each card contained the element's symbol, atomic weight and its characteristic_____
    _____
    d. From this table, Mendeleev developed his statement of the periodic law and published his work

14. The advantage of Mendeleev's table over previous attempts was that it exhibited ___
_____
_____
_____

    a. After redetermining atomic weights, some elements still needed to be placed out of order of their atomic weights.
    b. From the gaps present in his table, _____
    _____
    _____
    c. The elements _____were found later to fit his predictions quite well.
    d. Even if Mendeleev's table was published before Meyers', his work was_____
    _____
    _____
    _____

15. In all **Mendeleev predicted the existence of 10 new elements, of which seven were eventually discovered** -- the other three, atomic weights 45, 146 and 175 do not exist.

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Discovery of the Noble Gases

16. In 1895, the discovery of a new gaseous element named argon, which proved to be chemically inert and did not fit any of the known periodic groups.
17. In 1898, argon was placed into the periodic table between chlorine and potassium in a family with helium
18. It remained for the discoveries of scientists of the 20th Century to explain why the properties of the elements recur periodically.
19. With the discovery of isotopes of the elements, it became apparent that _____ _____was not the significant player in the periodic law as Mendeleev, Meyers and others had proposed.
20. It has become quite clear that the properties of the elements varied periodically with _____
21. The question of why the periodic law exists was answered as scientists developed an understanding of the electronic structure of the elements

The Modern Periodic Table

22. The last major changes to the periodic table resulted from _____ _____
23. Starting with his discovery of _____in 1940, he discovered all the transuranic elements from 94 to 102.
24. He reconfigured the periodic table by placing the _____ _____
25. In 1951, Seaborg was awarded the Nobel Prize in chemistry for his work. Element 106 has been named seaborgium (Sg) in his honor.

Parts of the Periodic Table

26. Rows on the Periodic Table are called _____
27. They are number 1 to 7. These numbers correspond to _____ _____

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28. The columns on the Periodic Table are called _____

    _____

29. The elements are grouped according to the physical and chemical properties.
30. The columns a numbered 1 to 18
31. The old system used Roman numerals and letters to denote groups and subgroups

Element Families on the Periodic Table

32. The 116 elements can be put into families (groups) by their properties,
33. These groups are _____

    _____

    _____

Alkali Metals

34. Found in _____
35. Are very reactive metals that do not_____
36. These metals have only _____electron in their outer shell.
37. Therefore, they are ready to lose that _____electron in ionic bonding with other elements.
38. The alkali metals are _____

    _____

39. Cesium and francium are the _____
40. The oxidation number for these metals is always _____

Alkaline Earth Elements

41. The alkaline earth elements are metallic elements found in_____
42. The alkaline earth elements are: _____

    _____

    _____

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43. All alkaline earth elements have _____electrons to give away
44. The oxidation number of_____, which makes them very reactive.

Transition Metals

45. 38 elements in groups _____of the periodic table are called "transition metals".
46. Have the properties of _____
47. The interesting thing about transition metals is that _____ _____ _____
48. Three noteworthy elements in this family are_____ _____

and are the only elements known to produce a _____field.

49. The oxidation numbers are _____

Other Metals

50. 7 elements classified as "other metals" are located in _____
51. They are not the same as the _____elements.
52. These elements, unlike the transition elements, do not exhibit varying oxidation states,
53. Their valence electrons are only present in their_____
54. They have oxidation numbers of_____

Rare Earth Elements

55. The thirty rare earth elements are composed of the lanthanide and actinide series.
56. One element of the lanthanide series and most of the elements in the actinide series are called_____, which means synthetic or man-made. All of the rare earth metals are found in Group 3 and the 6th and 7th periods. All rare earth elements have _____

electrons in their outer shells. They have varying oxidation numbers that are always _____

Non-Metals

57. Non-metals are the elements in groups _____
58. Non-metals are not able to conduct electricity or heat very well.
59. These elements show non-metallic characteristics. The non-metals are in all two or the three states of matter at room temperature' gases (such as oxygen) and solids (such as carbon).
60. They have oxidation numbers of: _____

Metalloids

61. Metalloids are the elements found along the stair-step line that distinguishes metals from non-metals.
62. This line is drawn from between _____and_____to the border between _____and _____.
63. **Only** exception to this is_____, which is considered to be an "other metal".
64. Metalloids have properties of both_____.
65. Metalloids, such as_____, are semi-conductors. This means that they can carry an electrical charge under special conditions. This property makes metalloids useful in _____

Halogens

66. The halogens are five non-metallic elements found in Group 17
67. These elements are:_____

    _____
68. The term "halogen" means "salt-former" and compounds containing halogens are called_____ "

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69. All halogens have _____electrons in their outer shells, giving them an oxidation number of _____
70. The halogens exist, at room temperature, in all three states of matter:
    a. Solid- Iodine, Astatine
    b. Gas- Fluorine, Chlorine
    c. Liquid- Bromine

Noble Gases

71. The six noble gases are found in_____.
72. These elements are: helium, neon, argon, krypton, xenon, and radon.
73. Because their oxidation number is_____,the noble gases have great difficulty forming compounds.
74. All noble gases have 8 electrons in their outer shell, making them stable.

Filling of Electron Sublevels and the Periodic Table

75. The outermost electron configuration can be determined from the Periodic Table. The order of fill of electrons is directly related to the Periodic Table
76. (long form is easier). Here is how it works:

77. The elements in Groups 1 and 2 are filling the _sublevel.
78. Examples: Li and Be are in the second period and fill the 2*s*.
79. Na and Mg will fill the 3*s* and so it goes.

80. The elements in groups 13-18 fill the _____sublevels, which can hold 6 electrons.
81. The *p* sublevels begin to fill in the _period with boron (B) and is completed with Ne.
82. In the third period Al to Ar complete the 3*p* sublevel.

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83. The transition metals in Groups 3-12 fill the _____sublevels.
    a. Remember *d*'s can hold ___ electrons.
    b. We do not see *d* sublevels until the _____ period.
    c. The _____ is already filled. Elements 21 to 30 fill the _____sublevel and 39 to 48 fill the _____ sublevel.

    Note: the principal quantum of the *d* sublevel being filled is always one less than the period number.

84. The two sets of elements that sit at the bottom of the short Periodic Table contain 14 elements. These are called the _____ metals and found in periods _____ and_____.
    a. The *f* sublevels are being filled and can hold 14 elements. The principal quantum number for the *f* sublevels is 2 less than the period. (Period 6 the 4*f* fills and Period 5 fills the 5*f*)

Here is it is the way to figure outer most electron configuration.

85. **n** is the period or principal quantum number.

Group	1	2	13	14	15	16	17	18
Outer configuration	$\mathbf{n}s^1$	$\mathbf{n}s^2$	$\mathbf{n}s^2\mathbf{n}p1$	$\mathbf{n}s^2\mathbf{n}p^2$	$\mathbf{n}s^2\mathbf{n}\,p^3$	$\mathbf{n}s^2\mathbf{n}p^4$	$\mathbf{n}s^2\,\mathbf{n}p^5$	$\mathbf{n}s^2\mathbf{n}p^6$

86. Okay some problems. In **Groups 3-12** the outer most electrons are always in $\mathbf{n}s^{2.}$ BUT the ***d* orbitals are filling**. SO ***s* and *d* electrons can sometimes move between sublevels creating different outer shell configurations.**

Periodicity of Properties

87. With increasing atomic number,
88. The electron configurations of_____.
89. Because of this the elements show periodic variations of both _____ _____ _____

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90. The periodic law states that _____

_____

91. Four physical properties of an atom: atomic radius, ionization energy, electron affinity and electronegativity.

Atomic Radius

92. The size of the electron cloud increases as the principal quantum number increases.
    a. Therefore, as you go down a group of elements, the size of atoms in is going to increase.
    b. Left to right across a period, all the atoms have _____
    c. For each element, the positive charge on the nucleus increases by one proton. This means that the outer electron cloud is pulled in a little closer to the nucleus.
    d. One periodic property of atoms is that they tend to _____ ___in size from left to right across a period of the table.
    e. So here is the trend for atomic radii: _____

    _____

    _____

    _____

Ionization Energy

93. The energy needed to remove_____

_____from an atom is known as ionization energy.
    a. The ionization energy tends to _____as atomic number increases in any period.
    b. In any group, there is a gradual _____in ionization energy as the atomic number increases because the electrons being removed are _____from the nucleus.

c. However it is more difficult to remove other electrons because of greater pull from the nucleus.

d. Metals typically have _____ionization energy. (easy to remove e^{-1})

e. Nonmetals typically have _____ionization energy.(hard to remove)

Electron Affinity

94. The attraction of an atom for an electron is called _____

a. Metals have _____ electron affinities (don't want electrons)

b. Nonmetals have _____electron affinities. (Really want electrons)

c. The general trend as you go down a group is a _____ _____

tendency to gain electrons.

d. As you go across a period there is a trend for a _____ ___attraction for electrons.

Electronegativity

95. Electronegativity is measure of the power of an atom in a chemical bond to attract electrons.

a. This is measured in Pauling units.

b. The electrons involved in a chemical bond are called _____

c. These are found in the _____energy levels

d. The bonding electrons are usually _____orbital electrons.

e. In a group, electronegativity will _____as you go down or remain almost the same.

f. Across a period there is a gradual _____in electronegativity.

g. Nonmetals are generally _____electronegative than metals.

h. The Halogens are the _____electronegative and the alkali

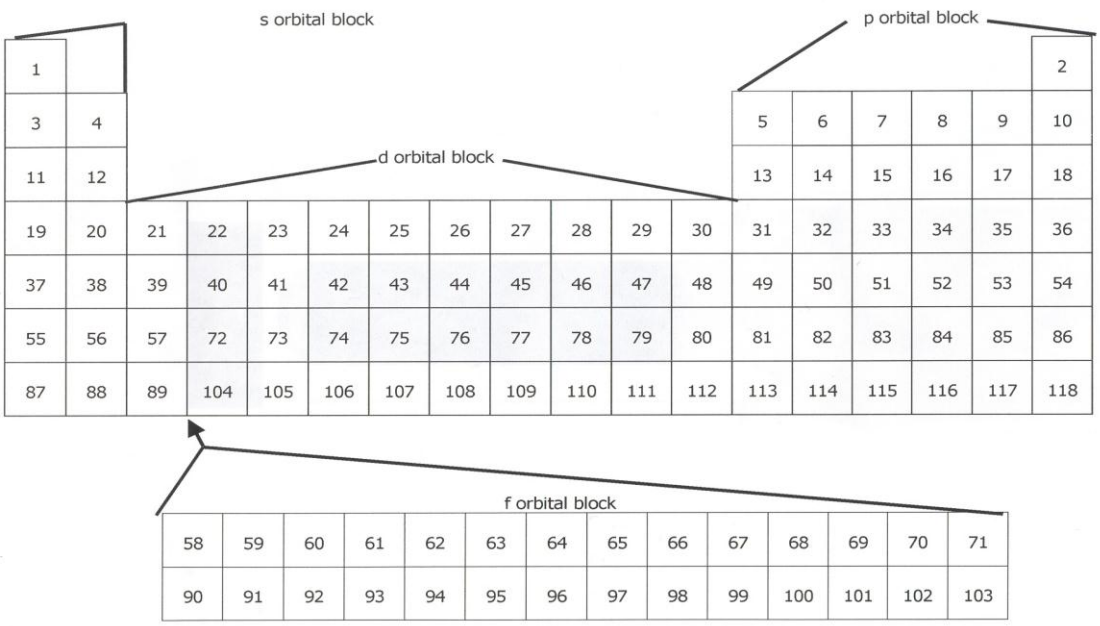
i. Alkaline earth metals are the _____electronegative.

96. Atomic radius also plays apart.

a. **Larger** more easily ionized **atoms** will **not attract electrons as strongly**.

b. **Fluorine is the most electronegative element** on the Periodic Table.

Chemistry I: Electron Configuration and the Periodic Table



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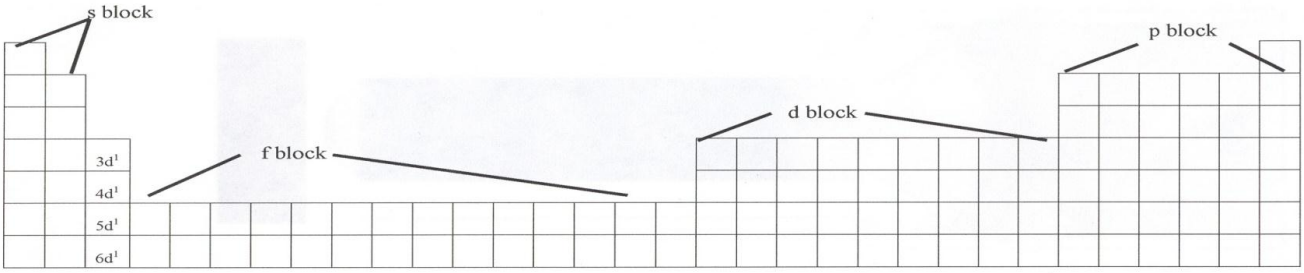
Chemistry I: Periodic Table & Electron Configuration / Order of Fill